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VOLUME I
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CONCEPTUAL DESIGN ANALYSIS
NORTHWEST BOUNDARY CONTAINMENT/
TREATMENT SYSTEM
ROCKY MOUNTAIN ARSENAL
COMMERCE CITY, COLORADO
FY 82 MCA LINE ITEM 37
DACA 45-82-C-0064

VOLUME I

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13. ABSTRACT (*Maximum 200 words*)

THE PURPOSE OF THIS CONCEPT DESIGN ANALYSIS IS TO DEFINE THE FOLLOWING FOR THE NORTHWEST BOUNDARY CONTAINMENT/TREATMENT SYSTEM:
1. FUNCTIONAL AND TECHNICAL REQUIREMENTS
2. BUILDING AND EQUIPMENT REQUIREMENTS
3. SUPPORT SYSTEMS.

SPECIFICATIONS ARE INCLUDED FOR THE FOLLOWING ELEMENTS:
1. CARBON TREATMENT SYSTEM
2. SITE DEVELOPMENT - GRADING AND PLACEMENT
3. BUILDING DETAILS - WALLS, FLOORS, ETC.
4. STRUCTURAL DETAILS - STEEL AND FOUNDATIONS
5. MECHANICAL - PLUMBING AND PIPES
6. ELECTRICAL.

VOLUME II CONTAINS COST ESTIMATES AND DESIGN CALCULATIONS.

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CONCEPT DESIGN ANALYSIS
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VOLUME II

SECTION 1

GENERAL DESCRIPTION

1.1 PURPOSE

The purpose of this Concept Design Analysis is to define the functional and technical requirements, equipment requirements, building requirements and support systems for the Northwest Boundary Containment/Treatment System at Rocky Mountain Arsenal. The new facility is to reduce contaminant levels of the groundwater aquifer to acceptable environmental discharge limits.

An additional purpose of this Study was to develop a Concept Cost Estimate including sufficient back-up data to enable review of the results.

1.2 AUTHORIZATION

This Project is authorized by Directive No. 2, Design FY82 MCA - Rocky Mountain Arsenal, dated 8 January 1982 and as defined by Appendix "A" to Contract DACA 45-82-C-0064 (Project 37) dated 26 May 1982.

1.3 SCOPE

The Scope of Work authorized is described in detail in Appendix "A" dated 26 May 1982 Contract Number DACA 45-82-C-0064 titled "Project 37 - NORTHWEST BOUNDARY CONTAINMENT/TREATMENT SYSTEM, Rocky Mountain Arsenal, Colorado".

In general, the Scope of Work provides for a Concept Design Analysis with optional Final Design Analysis for treatment equipment, building and support utilities to serve the facility. This effort is to include providing contaminated water pumps and associated piping to route groundwater through the treatment equipment and return the water to a treated water sump for aquifer reinjection. Raw water and treated water sumps will be designed by the Omaha District of the Corps of Engineers.

The cost limitation for the Concept Design Scope of Work is $44,745 and the optional Final design is $62,799. The programmed amount for the Northwest Boundary Containment/Treatment Facility is $2,000,000.

1.4 CRITERIA

The facility has been designed in accordance with the Project Development Brochure, and associated Enclosures and the Architect-Engineer Instruction Manual for Design of Military Projects, dated January 1981.

1.4 CRITERIA (continued)

In addition, the facilities also meet the latest requirements as noted in:

- Appendix "A" dated 26 May 1982.

- Supplement to Appendix "A" dated 26 May 1982 and associated applicable Technical Manuals, Guide Specifications, Design Criteria and specific Engineering Instructions referenced therein.

- Telephone Conversation with C.O.E. Confirmation Notice No. 2 dated 10 June 1982.

- Telephone Conversation with C.O.E. Confirmation Notice No. 3 dated 29 June 1982.

1.5 PROJECT DESCRIPTION

The treatment system at the Northwest Boundary at Rocky Mountain Arsenal is to reduce organic contaminant levels to a quality as established by the Colorado Department of Health. Dibromochloropropane (DBCP) is the only hazardous constituent presently identified and a maximum effluent concentration of 0.2 ug/l has been established. The facility will process 1500 gallons per minute (GPM) maximum of raw water through the facility with a maximum design influent concentration of 1.0 ug/l DBCP and 10 ug/l Total Organic Carbon (TOC). The system is to utilize a high efficiency carbon adsorption system similar to designs currently utilized on the Arsenal. The treatment system shall also provide adequate fresh and spent carbon handling procedures to support operations of the adsorption system. The equipment shall be contained in a pre-engineered metal building.

1.5 PROJECT DESCRIPTION (continued)

Design of the system and building occupancy shall be based upon operation and maintenance of the facility with one part-time person. Routine operational checks of the facility shall be made once weekly with maintenance functions performed as required.

1.6 APPLICABLE DRAWINGS

The following Drawings are pertinent to the Concept Design for this project:

General

L-1	Legend
G-1	General Arrangement.

Process

F-1	Flow Diagram Feed Pumps/Filters System
F-2	Flow Diagram Carbon Adsorption System
F-3	Flow Diagram Carbon Handling System.

1.6 APPLICABLE DRAWINGS (continued)

Architectural

A-1 Plans, Elevations, Sections & Details.

Electrical

E-1 MCC One Line Diagram

1.7 COST ESTIMATE SUMMARY

Following is enclosed the Concept Estimate Summary for construction of the Water Treatment Facility for the Northwest Boundary Containment/Treatment System. The backup of the estimate can be found in Volume II, Section I, Cost Estimate Backup.

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CONCEPT ESTIMATE

NORTHWEST BOUNDARY CONTAINMENT/TREATMENT SYSTEM
Project 37 Design FY 82 MCA
Rocky Mountain Arsenal, Colorado

1.	Process Equipment		$ 903,000.
2.	Building		
	Architectural - Structural		84,000.
	Mechanical		149,000.
	Electrical		53,000.
	ESTIMATED CURRENT CONTRACT COST - BUILDING		$1,189,000.
	Cost Growth to May 1983	- 6.0%	71,000.
		SUBTOTAL	$1,260,000.
	Contingency	- 5.0%	63,000.
		SUBTOTAL	$1,323,000.
	S & A	- 5.0%	66,000.
	ESTIMATED PROJECT COST - BUILDING		$1,389,000.
3.	Support Utilities		
	Building Excavation		$ 500.
	Fuel - Propane		5,000.
	Sanitary - Septic/Leaching System		4,000.
	ESTIMATED CURRENT CONTRACT COST - SUPPORT UTILITIES		$ 9,500.
	Cost Growth to May 1983	- 6.0%	500.
		SUBTOTAL	$ 10,000.
	Contingency	- 5.0%	500.
		SUBTOTAL	$ 10,500.
	S & A	- 5.0%	500.
	ESTIMATED PROJECT COST - SUPPORT UTILITIES		$ 11,000.
	TOTAL ESTIMATED PROJECT COST - CONSTRUCTION		$1,400,000.

SECTION 2

PROCESS

2.1 SYSTEM DESCRIPTION

2.1.1 General

The treatment system shall consist of a high efficiency carbon adsorption process designed to remove specific organic contaminants from the raw feed water. Three identical parallel treatment trains will be utilized. A common feedwater sump shall be provided with each treatment train having a separate feed pump. Water from the sump shall be pumped through a pre-filter to remove suspended solids larger than 100 microns prior to entering the carbon adsorption unit. A flow control valve will be used to maintain a constant flow into the adsorber vessel. The adsorption unit shall be of a countercurrent, pulsed bed design using activated granular carbon as the adsorption media. Effluent from the adsorption unit will pass through a 100 micron post-filter where entrained carbon particles will be removed. The treated water will then be discharged into a common sump.

The following design criteria have been utilized as the basis for the treatment system design.

A. The system shall be designed to remove organic contaminants, specifically dibromochloropropane (DBCP), from the groundwater using carbon adsorption. The Influent Concentration levels are to be: DBCP maximum concentration level of 1.0 ug/l; Total Organic Carbon maximum concentration level of 10 ug/l.

2.1.1 General (continued)

B. A high efficiency, countercurrent, multiple stage adsorption treatment shall be used in order to maximize granular activated carbon utilization.

C. The treatment shall use 12 x 40 mesh virgin granular activated carbon, WESTVACO WV-G or equal. Hydraulic loading shall not exceed 8 gpm/sq.ft., with a minimum empty bed contact time of 15 minutes for the carbon contactor. Maximum Design Flow Rate shall be 1500 gallons per minute (GPM).

D. The design shall provide for continuous non-supervised operation of the treatment system with monitoring and control functions manually initiated.

E. The treatment system shall be compatible with systems currently in operation at Rocky Mountain Arsenal.

F. The treatment system shall be designed such that the maximum effluent concentration of DBCP is 0.2 micrograms per liter (ug/l), in accordance with the Colorado Department of Health Standards.

2.1.2 Operating Scenario

Contaminated groundwater is pumped from dewatering wells into a raw water sump at flow rates up to 1500 gpm. The treatment system pumps the raw water from the raw water sump through cartridge prefilters, granular activated carbon Pulse Bed Adsorbers, in-line automatic backwash tubular post-filters and into a treated water sump.

2.1.2 Operating Scenario (continued)

The treatment system consists of three (3) identical parallel treatment trains. Each train is capable of pumping and treating raw water flows up to 500 gpm. The feed pump for each train is controlled by the liquid level in the raw water sump. When a feed pump for a given treatment train is energized by the liquid level rising to a designated high level in the raw water sump, that train commences to treat a flow of 500 gpm until a designated low level in the raw water sump is reached and the pump is automatically shut off. A common standby pump is provided to be utilized when one of the main pumps is out of service. Each train contains rate of flow control and maximum pressure control devices. The raw water is pumped through prefilters with replaceable filter cartridges for the purpose of removing suspended solids which could interfere with the flow characteristics of the granular activated carbon in the Pulse Bed Adsorber.

The Pulse Bed Adsorber is a fixed bed adsorber operated in the upflow mode. Periodically, small amounts of carbon are removed from the influent side (bottom) of the adsorption bed and an equal amount of fresh carbon is added at the effluent side (top). The amount removed and replaced is approximately five percent (5%) of the total bed. Thus, carbon efficiency is equivalent to having twenty (20) adsorption beds in series and operated in a countercurrent mode. Each adsorber contains 1400 cubic feet of carbon which provides a residence time of twenty-one (21) minutes.

2.1.2 Operating Scenario (continued)

Following carbon treatment, flow from each of the three (3) treatment trains is manifolded together and passes through an in-line tubular post-filter subsystem for removal of carbon fines. The filter is automatically backwashed upon manual initiation. Backwash water conveying carbon fines is flushed to the Spent Carbon Storage Module. The treated water is discharged into the treated water sump.

Carbon slurry handling for the removal of spent carbon from and the addition of fresh carbon to the Pulse Bed Adsorbers is carried out by a separate subsystem. Included in this subsystem are Fresh and Spent Carbon Storage Modules and a Dual Blowcase Module. This subsystem provides the carbon slurry handling requirements for the three (3) treatment trains. The Dual Blowcase Module contains two (2) pressure vessels, one for spent carbon and one for fresh carbon, each of which has capacity for 2000 pounds of carbon. Periodically, while the Treatment System is in normal operation, a pulse of spent carbon is transferred by means of slurry water from the bottom of the adsorber into the Spent Carbon Blowcase. An equal pulse of fresh carbon is transferred by means of compressed air from the Fresh Carbon Blowcase to the top of the adsorber. The spent carbon is then transferred by means of compressed air from the Spent Carbon Blowcase to the Spent Carbon Storage Module which has a capacity of 700 cubic feet of granular activated carbon. The Fresh Carbon Storage Module has an equal storage capacity. Fresh carbon is transferred from the Fresh Carbon Storage Module to the Fresh Carbon Blowcase by means of an eductor.

2.1.2 Operating Scenario (continued)

Upon depletion of the stored fresh carbon a transport trailer delivers 700 cubic feet of fresh carbon to the treatment plant. The carbon is transferred from the trailer by eductor to the Fresh Carbon Storage Module. Upon completion of the fresh carbon transfer, the spent carbon is transferred by means of eductor to the transport trailer. The eductor water is drained from the truck and the drained spent carbon is transported from the plant site to a disposal site or a reactivation furnace.

Water drained from the carbon transfer trailer or any portion of the treatment system flows into the drainage collection system which discharges into the raw water sump.

2.2 EQUIPMENT DESCRIPTION

2.2.1 Feed Pumps

Four (4) feed pumps shall be utilized, one per treatment train with a fourth as standby. Piping shall be installed which will allow the standby pump to be used with any of the three treatment trains. The feed pumps shall be vertical centrifugal sump pumps equipped with adjustable float controls to maintain the required minimum submergence. Materials of construction shall be cast iron ASTM A48 Class 25. Preliminary design parameters are:

- 500 gpm
- 70 psig TDH
- 30 bhp, 1760 rpm.

2.2.1 Feed Pumps (continued)

The driver shall be a 460 V, 3 phase, 60 HZ electric motor with a TEFC enclosure.

2.2.2 Raw Water Filters

Each treatment train shall have two filters, in parallel, installed upstream of the carbon adsorption vessel. These filters shall be of the multi-cartridge type with 100 micron polypropylene cartridges housed in an ASME Code 150 psig vessel constructed of Type 316 stainless steel. Preliminary design parameters are:

- 250 gpm.
- 60 psig inlet.

Each filter shall have flanged outlets, as well as NPT vent, gauge and drain connectors. A flow control valve shall be installed in the piping to maintain a constant flow through the filter into the adsorber. The function of the prefilters shall be to remove suspended solids from the influent stream which may foul the adsorber.

2.2.3 Adsorbers

Actual removal of the DBCP shall be accomplished by the physical adsorption of the organic molecules on the surface of activated granular carbon contained within the adsorbers. The design shall use 12 x 40 mesh virgin granular activated carbon, WESTVACO WV-G or equal. Three adsorbers shall be operated in parallel. Each adsorber shall contain 1400 cubic feet of carbon which will provide a resident time of 21 minutes.

2.2.3 Adsorbers (continued)

The adsorbers shall be fixed bed units operated in a upflow mode with incremental removal and replacement of carbon from the contactor. A pre-assembled modular package shall be utilized. Liquid influent will enter the column at the bottom and pass upward through the carbon bed with the treated liquid discharged from the top. Periodically, spent carbon equal to about 5% of the total volume will be withdrawn or pulsed from the bottom of the vessel. At the same time an equal amount of fresh carbon will be added to the top of the vessel. Carbon flow shall be countercurrent to the liquid flow.

The adsorber vessels shall be ASME Code, vertical cylindrical with a 40 mil lining of Plasite 4020 or equal. The associated piping shall be polypropylene lined steel. The preliminary design parameters for the adsorbers are:

- 500 gpm influent
- 50 psig @175° F
- 10'0" dia x 16'-0" S/S
- Dished heads

Materials of construction for the vessels and skids are to be carbon steel, primed and painted.

2.2.4 Post-Filters

Effluent from the adsorber shall pass through a post-filter to remove entrained carbon particles prior to discharge into the treated water sump. The filter shall be a commercially available modular unit consisting of multiple tube filters operating in parallel with at least one tube as a standby. The filter septums shall be selected to remove suspended solids 100 microns or larger. An automated backwash cycle shall be provided as a means of periodically cleaning the filter septum. The backwash cycle shall be initiated manually by the operator. Water from the backwash cycle shall be obtained from the treated water line and the pressure increased by the use of a centrifugal booster pump. Discharge from the backwash cycle will be piped into the spent carbon storage vessel for eventual disposal.

Preliminary design parameters for the post-filter are:

- 1500 gpm flow rate.
- 20 psig inlet pressure.
- 75 psig backwash water pressure.

Materials of construction shall be Type 316 stainless steel, ASME Code 150 psig. Air at 80 psig is required, as is electrical power - 110 V, 1 phase, 60 HZ.

2.2.5 Carbon Storage

Fresh carbon will be periodically delivered to the plant site by truck and transferred via a water educator into the fresh carbon storage vessel. This vessel will be a pre-assembled modular unit consisting of a 1000 cubic foot vertical cylindrical open top vessel with a 60° hopper bottom, structural supports, and associated polypropylene lined steel and PVC pipe, valves and fittings. The vessel shall have a 40 mil lining of Plasite 4020, or equal; and be constructed of carbon steel.

Spent carbon from the system will be transferred to the spent carbon storage vessel. Periodically, the spent carbon will be transferred via a water educator to a tank truck for removal from the plant site. The spent carbon storage shall be a pre-assembled modular unit consisting of a 1000 cubic foot vertical cylindrical open top vessel with a 60° hopper bottom; structural supports, and associated polypropylene lined steel and PVC pipe, valves and fittings. The vessel shall have a 40 mil lining of Plasite 4020, or equal, and be constructed of carbon steel.

2.2.6 Carbon Transfer

Transfer of carbon to and from the absorber shall be accomplished by the use of compressed air system. The transfer system shall consist of a pre-assembled modular dual blowcase unit, an air compressor and associated piping. The blowcase unit shall be skid mounted and contain two 700 cubic foot vertical cylindrical pressure vessels with 60° hopper bottoms. Both vessels are to be ASME Code, constructed of Type 316 stainless steel and be equipped with pressure relief valves. The modular unit will be supplied with polypropylene lined steel and PVC pipe, valves and fittings. Compressed air lines shall be carbon steel.

2.2.6 Carbon Transfer (continued)

An air compressor shall be installed to provide the transport media for the system. The preliminary design requirement for the compressor are:

- 25 scfm @ 80 psig
- 80 gallon receiver

The compressor shall be fitted with a pressure safety valve, high and low pressure limit switches and condensate drain. The driver shall be a 460 V, 3 phase, 60 HZ electric motor. Pressure gauges and regulators shall be installed to monitor and maintain the process requirements.

2.3 SPECIFICATIONS

The following Specifications will be required for preparation of Final Process Design documents:

	Carbon Absorption Equipment System Specification.
CE-504.01	Pumps; Water, Centrif.
CE-504.02	Pumps; Water, Vert. Turbine.
CE-15011	General Requirements Mechanical.
CEGS-15116	Welding, Mechanical.
CE-15178	Pressure Vessels for Storage of Compressed Gases.

SECTION 3

SITE DEVELOPMENT

3.1 SITE PLANNING

3.1.1 Plant Location

The Northwest Boundary Containment/Treatment Facility is located at the Southeast corner of the intersection of 9th Avenue, running east and west, and C Street.

3.1.2 Design Criteria

The prevailing winds are south at approximately 10 MPH according to the Technical Manual 5-785.

The design temkeratures are 1° F for winter and 92° F for summer according to the Technical Manual 5-785.

The normal annual precipitation is 16 inches according to the Climatic Atlas of U.S.

The frost line is 3'-6", design depth, to a maximum depth of 5'-0", according to AE1M dated 9 January 1981.

3.2 EARTHWORK

3.2.1 Site Preparation

Site preparation for this analysis include excavation and earthwork associated with the water treatment building. General site preparation will be the responsibility of the Corps of Engineers, Omaha District under overall site development efforts.

3.2.2 Special Precautions

Soils data has not been received so design considerations must be assumed. Strctural has assumed 3000 psi for concept design and that the building excavation will be backfilled with a granular structural backfill. Soil data will be supplied by the Corps of Engineers, Omaha District.

3.3 DRAINAGE

Positive drainage and final grading will be the responsibility of the Corps of Engineers, Omaha District.

3.4 UTILITIES

3.4.1 Water

Potable water line will be run parallel and on the south side of 9th Avenue. The Corps of Engineers, Omaha District is responsible for locating utilities.

3.4.2 Sanitary Sewer

A septic tank and leaching field will be located north of building.

3.5 SPECIFICATIONS

The following Specifications will be required for preparation of Final Site Development Design documents:

CEGS-02201 (TDSS)	Excavation, Filling and Backfilling for Building.
CEGS-02221 (TDSS)	Excavation, Trenching and Backfilling for Utilities Systems.

SECTION 4

ARCHITECTURAL

4.1 GENERAL

The Northwest Boundary Water Treatment Facility will be a pre-engineered metal building 40' wide by 77'-8" long by 30' eave height. The building will function to enclose the groundwater treatment equipment operations. The structure will be rigid frame including endwall frames to allow for future expansion. There will be a minimum of 28'-0" clear height in interior.

The building will be occupied once a week for inspection of operations. Maintenance crews will be on site as required. The building will contain one restroom facility consisting of toilet, lavatory and necessary accessories.

4.2 BUILDING DETAILS

4.2.1 Exterior Walls

The exterior walls will be the pre-engineered building manufacturer's standard profile color coated metal panel supported on girts. The walls will be insulated with fiberglass insulation and vapor barrier to a minimum U factor of 0.15.

4.2.2 Roof Construction

The roof will be the pre-engineered building manufacturer's standard profile.

The roof will be insulated with fiberglass insulation and vapor barrier to a minimum U factor of 0.10.

4.2.3 Interior Walls

There will be a color coated metal liner extending to 8'-0" above the floor around perimeter of building. The walls for the toilet will be painted concrete masonry block.

4.2.4 Floor Surfaces

The floor will be concrete with a wood float finish.

4.2.5 Ceilings

The equipment area will be open to the underside of the roof panels. The toilet will have a sloped ceiling constructed of plywood and metal studs.

4.2.6 Doors

Exterior doors, including hardware, will consist of two manually operated roll-up doors and three personnel hollow metal doors with glazing in upper half. The toilet door will also be a hollow metal flush door.

4.2.7 Windows and Glazing

There will not be any exterior windows and glazing will be in the personnel doors.

4.3 SPECIFICATIONS

The following Specifications will be required for preparation of Final Architectural Design Documents:

TD-206.02 (TDSS)	Masonry (Short form)(Small Structures).
TD-223 (TDSS)	Insulated Metal Panels.
CE-222.02 (TDSS)	Metal Roofing and Siding, Factory-Color-Finished.
CE-222.01 (TDSS)	Metal Roofing and Siding Plan.
CEGS-08810	Glass and Glazing.
CEGS-08710 (TDSS)	Hardware; Builders.
CEGS-08110 (TDSS)	Miscellaneous Doors.
CEGS-09910 (TDSS)	Steel Doors and Frames.
CEGS-10800	Toilet Accessories.
CE-201.01 (TDSS)	Metal Buildings.
CE-235.03	Rough Carpentry.

SECTION 5

STRUCTURAL

5.1 GENERAL

5.1.1 Design Criteria

Structural loading design criteria is based on the Architect Engineer Instruction Manual and supporting ANSI Standards.

The wind load is 24 PSF based on an 80 MPH wind in an ANSI Exposure 'C'.

The basic ground snow load is 35 PSF. The roof snow load is reduced to 30 PSF based on ANSI 7.2.1(3) because the building is located in a clear exposure and wind swept area.

The site is located in Seismic Zone 1.

The interior elevated walkway design load will be 100 PSF live load and dead load of 25 PSF.

5.1.2 Soil Bearing Capacities

Soil bearing pressure was assumed to be 3000 PSF. See Earthwork - Special Precautions paragraph 3.2.2.

5.1.3 Design Methods

The design methods are in accordance with the American Institute of Steel Construction 8th Edition and the American Concrete Institute 318-77 and its 1980 Supplement.

5.1.4 Design Stresses

Structural steel shall conform to American Society Testing and Materials (ASTM) A36. The allowable 28 day compressive stress for concrete shall be f_c of 3000 psf.

5.2 STEEL STRUCTURE

5.2.1 Building Frame Description

The building will be a pre-engineered metal building. It will be a clear span rigid frame structure with rigid frame in both endwalls to accomodate future expansion. The wall and roof panels will be supported on light gauge girts and purlins.

5.2.2 Platforms and Catwalks

The elevated catwalks will be steel grating supported by structural steel members. Access to catwalks will be by steel ladders.

5.3 FOUNDATIONS

5.3.1 Building

The columns will set on concrete piers that set on spread footings. There will be a grade beam between piers. Both the grade beam and footings will be at frost depth.

5.3.2 Equipment

Equipment pads will be elevated 6" above floor slab, including a 2" leveling grout. The pads will be strucutrally isolated and independent from adjacent floor slab.

5.4 SPECIFICATIONS

The following Specifications will be required for preparation of Final Structural Design documents:

CEGS-03300 (TDSS)	Concrete.
CEGS-03301 (TDSS)	Concrete for Bldg. Constr. (Minor Requirements).
TD-05410	Formed Steel Struct. Framing.
CEGS-05500	Miscellaneous Metals.
CEGS-05120 (TDSS)	Structural Steel.
CEGS-05141 (TDSS)	Welding; Structural.

SECTION 6

MECHANICAL

6.1 HVAC

6.1.1 Design Conditions

Design Conditions are based on Department of the Army Technical Manuals TM5-810-1 and TM5-785, Department of the Defense Military Manual DOD 4270.1-M and ASHRAE Handbook 1981 Fundamentals.

The design U value for the exterior walls is 0.15 BTUH/°F-FT^2 and the U valve for the roof is 0.10 BTUH/°F-FT^2. The building design winter interior temperature is 40°F and the design exterior temperature is 1°F. The winter design infiltration rate is 1 Air Change per Hour. The design winter interior temperature of the restroom is 60°F. The design summer interior temperature of the building is 102°F and the design exterior temperature is 91°F. The ventilation rate of the restroom is 10 Air Change per Hour.

The building is to be heated by four propane unit heaters. The building is to be cooled by natural ventilation through the use of gravity air movers in the roof. The restroom is to be heated by electric infrared heating. The restroom is to be ventilated by a fan in the ceiling and ducted to an exterior wall.

6.1.2 Equipment Selection

The propane fired propeller fan unit heaters have a capacity of 33,600 BTUH each. These are to be controled by thermostats, with a temperature range of 40 to 80°F. A 1000 gallon propane tank with the accessory valves and fittings shall be used.

Three 12 in. X 10 ft. gravity air movers shall be used to ventilate the building.

An exhaust fan with a capacity of 72 ACFM shall be used to ventilate the restroom. An electric infrared heater with a capacity of 500 W shall be used to heat the restroom. The heater shall be controlled by a thermostat with a temperature range of 40 to 80°F.

6.2 BUILDING PLUMBING

6.2.1 Potable Water

A potable water supply shall be installed in the facility to provide water for the sanitary equipment, wash down hoses, emergency eye wash and emergency shower. The potable water system shall be constructed of copper tubing with soldered fittings and conform to all applicable plumbing codes.

6.2.2 Sanitary Sewer

Effluent from the toilet and lavatory floor drain shall be routed to a septic tank sewage system located outside the building. The sanitary sewerage line shall be cast iron and shall include a vent line, cleanouts and traps.

6.2.3 Building Floor Drains

Drainage within the building shall be provided through the use of floor drains and drain trenches. The floor drains and drain trenches shall be interconnected via a drain piping system and shall gravity drain into the raw water sump. The floor drains and drain piping shall be cast iron. The drain trenches shall be concrete and be an integral part of the floor slab. The building drainage system shall conform to all applicable plumbing codes.

6.3 BUILDING PIPING

6.3.1 Design Conditions

The building process piping shall be a low pressure Class 150 system. All pipe, valves, fittings and connections shall conform to ANSI Class 150 standards. The maximum inside design building temperature shall be 102°F with a minimum inside design building temperature of 40°F. Design conditions of the process fluids are 40°F at 20-75 psig.

6.3.2 Material Requirements

All process piping, except the fresh carbon and spent carbon lines, shall be Schedule 80 PVC, Type 1, Grade 1, with socket end fittings. The PVC piping is to be joined by solvent cementing. Valves shall be PVC Class 150. The spent carbon and fresh carbon lines shall be polypropylene lined steel pipe with Class 150 flanged fittings. All valves in the spent carbon and fresh lines shall be polypropylene lined steel with Class 150 flanges. Compressed air line piping shall be Schedule 80 carbon steel with socket welded fittings.

6.3.3 Color Coding Requirements

All piping shall be color coded and identified with bands and legends as specified in COE Specification OD-15047, "Identification of Piping", December 1977.

6.4 SPECIFICATIONS

The following Specifications will be required for preparation of Final Mechanical Design documents:

CE-300.01	Plumbing, Gen. Purpose
CEGS-02713	Water Lines.
CEGS-05141	Welding, Struct.
CEGS-15302	Sewer. San. Gravity
CE-300.05	Gas Fitting.
CE-301.08	Ventilating System, Mechanical.
CEGS-07840	Roof Ventilators, Gravity Type.
CEGS-15773	Heating Systems, Gas-Fired Heaters.

SECTION 7

ELECTRICAL

7.1 GENERAL

The required electrical installations for the water treatment building are limited to equipment on and within the building, with the exception of certain interfaces, which will extend to a maximum distance of a 5 foot perimeter around the building.

The electrical distribution system portion includes supplying only that equipment serving power, heating and lighting within the building, plus power to the four raw water feed pumps located exterior to the building structure and adjacent thereto.

The only requirement for the telephone system is an empty conduit for routing the wiring within the building to an external interface point. A steel pull wire will be provided in the conduit for future telephone cable installation.

7.2 DISTRIBUTION SYSTEM

A 480V, 3Ø, underground service will be provided by others The interface point will be to the source side terminals of the motor control center (MCC) main circuit breaker located inside the building. The incoming service conduits for the MCC will be stubbed out from the building structure. All power will be distributed from the motor control center, either directly to the loads (480V, 3Ø) or through a 480V to 120/208V dry type transformer and a 3Ø, 4W, 120/208V surface mounted panelboard.

7.2 DISTRIBUTION SYSTEM (continued)

The MCC consists of an incoming compartment and main breaker, four feeder circuits to the raw water feed pumps, and three feeder circuits to the air compressor, booster pump and lighting panel transformer. Two spare equipped spaces are provided for future use. Ratings of the MCC are 480V, 3Ø, 3W, 600 amp bus. Main circuit breaker will be sized on loads as shown with 25% spare capacity or to other parameters as provided by the Corps of Engineers.

All power circuits will be installed in RGS conduit. Electrical metal tubing (EMT) may be used for lighting circuits. Minimum conduit size will be 3/4". Two 3/4" RGS empty conduits will be stubbed out underground from the lighting panel location for future use by others for lighting and power receptacles. Demand loads for required circuits shall be provided by the Corps of Engineers. All wiring will be copper with insulation rated 90°C for dry locations and 75°C for wet locations.

7.3 EQUIPMENT CONTROL

All equipment will be controlled at the motor control center with start/stop pushbuttons or HOA switches as required. Red and green indicating lights will indicate the on-off status of the equipment. Spare auxiliary contacts will be provided in the MCC starters for remote status indication and/or alarm if required in the future.

Additional requirements for locating and sizing control circuit conduits will be provided by the Corps of Engineers.

7.4 LIGHTING

Lighting and miscellaneous power loads will be served from a 120/208V, 3PH, 4-wire panel. The general interior lighting will be supplied by 6 suspended, 150W HPS lighting fixtures: Holophane Cat. No. 1938 with prismatic glass reflector, or equal. The general interior lighting level will be approximately 20FC maintained, as recommended by the IES for auxiliary areas (including tank, compressor and gage areas). An incandescent fixture, wall mtd., C.O.E. Type R2-D, will be provided for the lavatory. A wall mounted incandescent fixture, C.O.E. Type WB-1, will be located outside the building at the entry door. This fixture will be photo-cell controlled.

One incandescent fixture, Type VG-4, will be located inside between the entry door and the lighting panel. The switch will be located inside and adjacent to the door. The function of this fixture will be to provide instant illumination of the lighting panelboard, the pathway to it, and will provide illumination during the starting period for the HPS units. The HPS fixtures will be switched at the breaker panel.

The exit sign will be a self-contained unit with power pack and charger. Emergency lamps are switched on upon loss of normal power. One remote lamp head, sealed beam spot, will be powered by D. C. power pack on the sign. Unit operates on 120 volts. Miscellaneous loads served from the panel include the following: fans for four gas-fired unit heaters, convenience receptacle circuits, a small water heater for the lavatory, a lavatory space heater and a lavatory exhaust fan. Breakers are included in the lighting panel for two 1P, 20A and one 2P, 20A circuits for exterior lighting and power receptacles provided by others.

The lighting panel will be 3Ø, 4W, 120/208V with a 100 amp main breaker and 100 amp bus. The panel will be NEMA 1, surface mounted, with 20 bolt-on branch circuit breakers.

7.5 GROUNDING SYSTEM

A grounding system will be installed to effectively ground equipment, tanks and structure as required. The electrical system will be grounded in accordance with the latest edition of the NEC and the National Electric Safety Code, NBS Handbook 30.

The building will be encompassed by a #4/0 SDBC ground grid buried 2 feet below grade and located 3 feet minimum from the building foundation. Ground rods will be located at the building corners. The top of the ground rods will be located 2 feet below grade. Cross-run ground cables will be located approximately 3 feet below grade to avoid interference with floor trenches and equipment foundations. All steel columns will be grounded. All tanks and vessels will be effectively grounded at one point by means of a lugged pigtail connection to skirt. All grounding connections below ground will be exothermically welded. All connections above ground will be bolted and/or welded.

The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, two additional rods shall be installed no less than 10' on centers. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately in writing. All measurements shall be made in the presence of the Contracting Officer or his authorized representative.

7.6 LIGHTNING PROTECTION SYSTEM

The building to be erected for this contract is a pre-engineered metal building (light-weight steel). Lightning protection for this type of construction is not covered by the specific catagories of building construction described in detail in C.O.E. Pattern Guide Specification No. 303.09 dated 11/80.

7.6 LIGHTNING PROTECTION SYSTEM (continued)

The lightning protection system will be designed in accordance with Paragraph 2 of the document, i.e. "lightning protection systems for applications other than those specified herein shall conform to NFPA Code No. 78". Other portions of the specification will be used as applicable.

The lightning protection system will have a roof network and down conductors of soft drawn bare copper cable (approximately 3/8" diameter). The down conductors will be exothermically connected to the building ground grid. The roof air terminals will be 1/2" X 10" copper minimum.

The system will be constructed with materials suitable for Class I applications as listed in U.L., Inc. publication U.L. 96; Standard for lightning protection components.

7.7 SPECIFICATIONS

The following Specifications will be required for preparation of Final Electrical Design documents:

CEGS-16855	Electrical Space Heating Equipment.
CE-303.01 (TDSS)	Electrical Work, Interior.
CEGS-16601	Lightning Protection System.

Stearns-Roger

APPENDIX

APPLICABLE DRAWINGS

General

L-1	Legend
G-1	General Arrangement.

Process

F-1	Flow Diagram Feed Pumps/Filters System
F-2	Flow Diagram Carbon Adsorption System
F-3	Flow Diagram Carbon Handling System.

Architectural

A-1	Plans, Elevations, Sections & Details.

Electrical

E-1	MCC One Line Diagram